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A MICRO-SIMULATION MODEL FOR E-SERVICES IN CULTURAL HERITAGE TOURISM

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Abstract
Tourism is on a rising curve from both a policy and research perspective. This paper aims to present new research advances on individual tourist behaviour and motives, with particular reference to the role of e-services in cultural heritage tourism. An innovative tool used here is (spatial) micro-simulation modelling (MSM). This method will be used to offer a micro-based picture of the motives and behaviour of the total tourist and resident population concerned, including their preferences and personal characteristics. MSM is a novel, but hitherto hardly used, scientific tool in the behavioural analysis of cultural heritage tourism, mainly because of the lack of detailed and consistent (spatial) information on tourist flows and their characteristics at an urban scale. MSM is a powerful tool, as one of its advantages is its ability to link existing databases and information, so as to provide new behavioural insights at the meso-level of research. To trace empirically the motives, preferences and spatial behaviour of tourists, advanced micro-based research techniques are needed. In our empirical application to tourist flows in the city of Amsterdam we use factor analysis and ordered logit models as the foundation stones for the design of MSM. Our empirical model is then applied to the use of e-services by tourists in Amsterdam who wish to enjoy the cultural heritage of that city.

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1. Introduction

The trend towards a leisure society where rises in productivity and welfare have shaped the conditions for a significant increase in expenditures and in flexible time for discretionary consumption has been pervasive in the Western world in the past few decades. Recreation, culture and tourism are prominent examples of new lifestyles in our modern age. The growing flows of tourists to remote and peripheral areas indicate that both places of origin and of destination are affected by this mega-trend (see Fusco Girard and Nijkamp 2009). This drastic change in spatial behaviour is caused not only by economic prosperity and our welfare and leisure society but also by the use of the modern information and communication (ICT) sector, which offers: (i) more direct information on interesting places to visit; (ii) efficient technological tools to organize and book leisure trips; and (iii) techniques for communication with friends and relatives through which physical mobility will be enhanced (see also March 2009).

A main challenge of modern regional policy is to market – through the use of ICT – the attractiveness of a certain region in order to generate growth in tourist visits and expenditures. An important contribution of cultural heritage lies in the support of the destination image generation. This means that, for example, cultural heritage is not only a source of historical information affecting the image of the attraction itself, but also the broader destination image. Consequently, information provided to (potential) visitors has an impact on the destination image. Thus, ICT has become one of the competitive tools in regional tourist policy (see Goeldner and Ritchie 2006).

Amsterdam, for instance, has a dedicated policy that aims to strengthen its cultural profile. The city is known for its interesting links between the (urban) past and the future, which can be experienced in a lively cosmopolitan atmosphere. Clearly, cities like Barcelona, Rome, Lisbon and Prague are important competitors. Each destination offers a variety of products and services to attract visitors, and each tourist has the opportunity to choose from a set of destinations (Crompton 1992). Therefore, it is very important to know what the unique selling point of a particular city is, and how tourists can be (virtually) attracted. It is equally important to know how important cultural heritage is for the tourism sector and for the city as a whole at the individual (micro) level. This calls for due insight into the motives and preferences of tourists for different elements of cultural heritage, as well as for the sites they actually plan to visit.

The present paper aims to highlight the importance of ICT facilities for enhancing the tourist profile of a given city, in our case, Amsterdam. We will in particular address the critical importance of cultural heritage as a promising spearhead for the tourist attractiveness of host cities. In our analysis we will focus largely on individual (micro) preferences and attitudes of

visitors. To this end we will employ as a technical tool for decision support – in addition to ordered logit models and factor analysis – micro-simulation models (MSM), in order to investigate the driving forces which encourage visitors and residents to use e-services in the tourist sector with regard to cultural heritage.

The paper is organized as follows. In Section 2, we describe a few essential elements of cultural heritage in the context of tourism. Then, in Section 3, we highlight the use of ICT in the tourist sector. Next, Section 4 is devoted to the use of e-services in enhancing the benefits to visitors of cultural heritage amenities. Section 5 describes the research framework of our paper, while an analysis of tourist preferences is undertaken in Section 6, where a factor analysis is applied, in combination with the use of an ordered logit model. These ingredients lead to our MSM experiments which are presented in Section 7, and these are complemented with a sensitivity analysis. A target group analysis is then offered in Section 8, followed by concluding remarks in Section 9.

2. Cultural Heritage as a Tourist Asset

Tourism in our modern world appears in many different guises, but a significant part of tourism is due to the attractiveness of the cultural capital (e.g. cultural heritage) in destination cities. This has become a major economic asset in modern tourism (Ark and Richards 2006).

An important contribution to the destination image generation of cities does indeed originate from the attractiveness of cultural heritage. This means that cultural heritage is not only a source of historical information or place identity affecting the image of the attraction itself, but also influences the broader destination image of the city.

A significant part of the cultural history of our world is reflected in human-made assets that still reain from the past, and which have a unique social value, often referred to as ‘cultural heritage’ (Fusco Girard et al. 2008). Cultural heritage is generally defined as the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations. Often though, what is considered cultural heritage by one generation may be rejected by the next generation, only to be revived by a succeeding generation. Cunnell and Prentice (2000) make a distinction between tangible and intangible features of cultural heritage. Physical or ‘tangible’ cultural heritage includes buildings and historic places, monuments, artefacts, etc. that are considered worthy of preservation for the future. These include objects significant to the archaeology, architecture, science or technology of a specific culture. ‘Natural heritage’ is also an important part of a culture, encompassing the countryside and the natural environment, including flora and fauna. These kinds of heritage sites often serve as an important factor in a

country's tourist industry, attracting many visitors from abroad, as well as locally. The 'intangible cultural heritage' includes social values and traditions, customs and practices, aesthetic and spiritual beliefs, artistic expression, language, and other aspects of human activity. Naturally, intangible cultural heritage is more difficult to preserve than physical objects.

3. The Role of ICT

Tourism is no longer a technology-poor or low-tech activity. Nowadays, tourism is highly dependent on modern technological advances (see, e.g., Cooper et al. 2008; Giaoutzi and Nijkamp, 2006). It plays a critical role in local economic development in many countries and is an important constituent of the emerging global network society, which, is in turn, stimulated by the modern ICT sector. The Internet plays an indispensable role in international and national tourism, and will most likely become the critical tool for tourism in the future. The introduction of ICT in recent decades has created new opportunities for the tourist attractiveness of remote and peripheral areas, which themselves also now have a virtual access to major centres of tourist origin. This has also led to service competition between tourist facilities in areas of destination, where firms are increasingly involved in global competition (even when they belong to the SME sector).

The introduction of the various ICT applications related to the tourism sector is, inter alia, focusing on:

- The promotion of tourist destinations through the advertisement of the tourist product in the context of multimedia applications;
- Interactive communication between interested parties (tourist destination and the tourist);
- Online transactions between the tourist destination and the tourist, such as booking, payment, etc;
- Teleworking applications, which give the opportunity to combine work with vacations and thus eventually lengthen the duration of leisure time;
- Telemedicine applications, which encourage elderly people to enjoy themselves away from home;
- Transport telematics which aim at the more efficient management of the tourist flows, etc.

It is obvious that the ICT sector has drastically changed the tourist market. Many potential visitors already derive much pleasure from the fact that almost all tourist destinations can be seen on the PC screen. They also have become more critical of the type of facilities offered, while, at the same time, a large share of tourism bookings (hotels, flights, etc.) are done over the Internet.

And, more recently, we see a new ICT facility, where visitors can receive on the spot real-time information on forthcoming events. The tourist has become an emancipated visitor through the use of ICT. Here, the related services provided by ICT will be called ‘e-services’.

4. e-Services and Cultural Heritage

The structure of the tourist industry is rather complex and encapsulates intertwined links between travel agencies, tour operators, airlines, railway companies, firms, hotel and restaurant chains, tourist bureaus and the popular media. Since this industry has many specialized market niches, it is clear that tourism marketing, for which ICT is an important tool, has become a critical success factor (Giaoutzi and Nijkamp 2006). e-Services can have different interpretations in different subject areas (business, ICT, etc.). With respect to cultural heritage, e-service is defined as ‘the provision of services based on an interactive information exchange over an electronic network’ (Baida et al. 2004). According to Riganti et al. (2007), a shift from traditional ways of consuming cultural heritage to modern ways is likely to happen. This new way of experiencing cultural resources is often linked to ICT. Until now, ICT has mostly been applied in the digitalization of cultural goods, but there is also a move to e-heritage: digital environments are created which make cultural heritage more accessible (Riganti 2007). Examples are virtual tours and e-forums. A major question now is whether the provision and use of e-services will lead to a rise in tourist attractiveness and visits.

An important advantage of e-services is, first of all, that they can enhance and widen the access to cultural heritage. Via the Internet, people can easily find information with respect to both the cultural heritage of places they want to visit, and cultural objects they do not yet know (Scavarda et al. 2001). In other words, e-services provide the most effective way to communicate with the target market (Riganti et al. 2007). Because suppliers of cultural heritage can trace more information about the customer by checking his/her online history, demand can also increase because of the increased potential to provide personalized information (Scavarda et al. 2001). Secondly, e-services make the comparison between different cultural sites more easy for the consumer (Riganti et al. 2007). Information asymmetry on the side of the consumer is reduced and the consumer can make better decisions about which cultural heritage he or she wants to visit. A third advantage is the better availability of information about cultural heritage. It appears that local residents in particular are more aware of the importance of cultural heritage, and therefore want to preserve cultural heritage more (Azjen and Fishbein 1980). However, there are also some potential disadvantages of providing e-services. Firstly, since it is likely that there is more personalized and individually tailored information provided, there can be a conflict between needs and access conditions of different consumer groups. Secondly, because of the

improved accessibility of information, there will be more competition between suppliers of cultural heritage. This could even imply that cultural heritage sites that do not use e-services may be neglected, or consumers who do not have access to such e-services will be socially excluded (Rayman-Bacchus and Molina 2001).

5. Research Framework

In our empirical research framework, we are interested in analysing the preferences of visitors for various types of cultural heritage. Using micro-survey data we will employ an ordered logit model to identify the drivers of these preferences, in the context of the provision and use of e-services. Given the multidimensional nature of the data, factor analysis will be used to structure the data and to arrive at a systematic typology of visitors. This approach forms the basis for the final and critical step in our analysis, viz. the design of an MSM. Figure 1 shows the structure of data handling in our approach.

Important components for developing a micro-simulation model are the availability of a micro-population with a large number of relevant characteristics, as well as the availability of statistics about the subject and location under research. In our applied research in Amsterdam, there is micro-population information available from local choice experiments, relating to both tourists and (visiting) residents. The detail in data availability from local sources is, however, also very important, in particular to be able to choose the best constraint variables (see later). This is only possible when there is statistical information available at the municipality level (or at an even lower scale) concerning all relevant variables. For our case study of Amsterdam, fortunately sufficient information was available. By performing a micro-simulation, we were able to develop a picture of the total tourist/resident population of Amsterdam, with their relevant characteristics, allowing us to see which kinds of tourists are present already, and which new ones should be attracted.

e-Services have a broad meaning. Apart from having general e-services, Amsterdam is moving towards delivering e-services on mobile devices that can deliver information during the visit, and towards enabling visitors to experience the city's attractions both before and after the visit. The general idea is to provide an e-service in which a visitor can make a virtual walk through Amsterdam and learn more about the architecture, monuments and history of the city. The tour is made with state-of-the-art content and techniques, such as 360-degree photographs and Google-maps. The tour fits with the need of the city of Amsterdam to enhance its information on cultural heritage for visitors and citizens. The tour aims to reach a wide target group: people who have some interest in architectural history and want to be inspired to visit Amsterdam in a virtual way, as well as people with more than a general interest in architectural

history, who use the application as an extra possibility for the exploration of the history of the city. The virtual tour is combined with an interactive map. On the Amsterdam website, interactive maps, booking services, journey planners and personalized information can all be found. Furthermore, there is a webshop available on this site. From March 2009 onwards, this website will also offer an e-forum/e-participation. However, at present this e-service is not yet sufficiently defined.

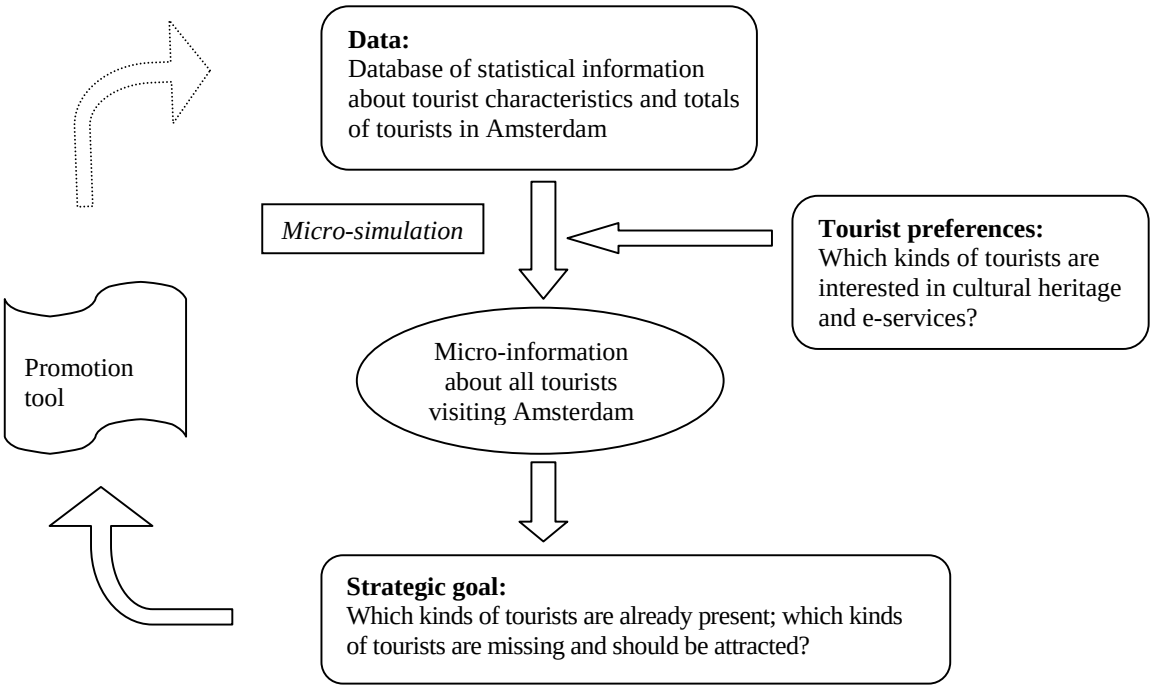

Figure 1. Data analysis framework

6. Tourist Preferences

6.1 Introduction

There have been several studies on the preferences of travellers; these studies often used conjoint analysis (a stated preference method) that has been successfully applied in tourism as a technique to describe and forecast tourist choice behaviour (Suh and McAvoy 2005, Riganti and Nijkamp 2008). Important factors that influence people's choice of destination are: age, income, gender, personality, education, cost, distance, nationality, risk, and motivation, etc. (Hsu et al. 2009, Kozak 2002). In addition, information sources and previous experiences also affect the destination choice of visitors.

The data used for this analysis were collected by user surveys carried out in the city of Amsterdam between August and November 2007. These surveys involved extensive field data

collection by interview teams who were hired and professionally trained. The questionnaires used both online and face-to-face interview modes (stand-alone computer versions or paper versions). In total, around 650 tourists each filled in a questionnaire.

In the survey, respondents were asked to value several cultural heritage characteristics (among others, the presence of museums, architecture, and cultural festivities in Amsterdam) and e-services (such as online booking, virtual tours, journey planner, etc.). Since these valuations of cultural heritage characteristics and e-services are captured into discrete (in contrast to continuous) dependent variables – ranging from 'not important' to 'very important' in five categories – standard regression tools are not applicable. Fortunately, appropriate discrete choice models are available to study how the individual characteristics of respondents influence the valuation of cultural heritage. In this section we use an ordered logit model, an econometric tool frequently used in applied behavioural research (Hensher et al. 2005). The ordered probability model is an extension of the binary probability model, whereby the dependent (qualitative) variable has a limited number of ordered outcomes. The requirement of ordering is necessary, and this is present in the cultural heritage survey; the level of importance indicated by the respondents is a clear example of a discrete ordered (ranked) dependent variable.

Although the results of the behavioural models are very interesting, they are also very heterogeneous, and therefore we will also use a factor analysis approach. Factor analysis is a multivariate statistical approach that can be used to analyse interrelationships between a large number of variables, and to explain these variables in terms of their common underlying dimensions. The underlying assumption is that there exists a number of unobserved latent 'factors' that account for the correlations among observed variables. The main purpose of factor-analytic techniques is to reduce the number of mutually-correlated variables, and/or to detect underlying patterns or a structure in the relationships between variables. In our case, however, the aim is not in particular to condense the number of variables, but with a limited number of factors, it is easier to identify significant differences between groups of tourists or residents. Here, we use specifically a principal component analysis with a varimax rotation. The factors extracted by this method are by definition uncorrelated and can be arranged in order of decreasing variance. To easily interpret the factors, we focus on components with a loading higher than 0.4, although variables with a loading equal to, or greater than, 0.35 may still be meaningful in order to decrease the probability of misclassification (Hair et al. 1995).

6.2 Preferences for cultural heritage

In this section, we investigate distinct classes of tourists and their preferences for different kinds of cultural heritage. The ordered logit models provide insight into which combinations of the characteristics of the tourists affect their preferences. We analyse which personal

characteristics correlate with 8 different types of cultural heritage (see Table 1). The tourist characteristics that we included as explanatory variables in our models are dummies for the use of e-services, age, income level, education level, gender, and for being employed or not. Furthermore, country-of-origin dummies are added, to correct for country-specific characteristics.

Table 1. Coefficients of the ordered logit models estimating the preferences of tourists in Amsterdam for different kinds of cultural heritage

	Architecture	Monuments	Museums	Urban landscape	Cultural events	Traditions	Customs	Knowledge
e-Service	0.205 (0.160)	0.319** (0.152)	0.581*** (0.154)	0.334** (0.155)	0.262* (0.151)	0.257* (0.160)	0.180 (0.154)	0.014 (0.157)
Age	0.193* (0.113)	0.392*** (0.108)	0.338*** (0.106)	0.213** (0.101)	-0.351*** (0.107)	-0.362*** (0.119)	-0.197* (0.120)	0.062 (0.115)
Education	0.229*** (0.068)	0.090 (0.065)	0.103 (0.067)	0.187*** (0.063)	-0.108* (0.059)	-0.098* (0.059)	-0.121** 0.056	-0.132** (0.059)
Gender	0.255* (0.147)	0.269** (0.141)	0.310** (0.146)	0.528*** (0.144)	0.109 (0.140)	0.481*** (0.143)	0.380*** 0.141	0.248* (0.143)
USA	0.233 (0.221)	0.254 (0.217)	-0.076 (0.217)	-0.039 (0.214)	-0.747*** (0.224)	1.790*** (0.252)	1.503*** 0.240	1.199*** (0.245)
UK	0.210 (0.228)	-0.004 (0.247)	-0.271 (0.253)	-0.260 (0.234)	-0.785*** (0.254)	1.915*** (0.244)	1.518*** 0.255	1.588*** (0.271)
Germany	0.554** (0.252)	-0.494** (0.255)	-0.030 (0.249)	-0.308 (0.251)	-1.338*** (0.249)	0.568*** (0.222)	0.227 0.228	0.270 (0.227)
Rest of Europe	0.492** (0.219)	-0.298 (0.223)	-0.218 (0.222)	-0.160 (0.225)	-0.796*** (0.224)	1.237*** (0.234)	1.189*** (0.225)	1.032*** (0.212)
Rest of the world	0.305 (0.323)	-0.075 (0.304)	0.390 (0.291)	-0.224 (0.307)	-0.775*** (0.286)	1.597*** (0.323)	1.301*** (0.283)	0.951*** (0.294)
Observations	371	364	361	372	363	367	353	357
McFadden pseudo-R^2	0.032	0.015	0.012	0.010	0.029	0.018	0.009	0.013

*Note: Significant at the *** 0.01, ** 0.05 and * 0.10 levels.*

A first important variable for the tourists visiting Amsterdam is the use of e-services for planning leisure activities. Table 1 shows that tourists who do use e-services often have a higher preference for all kinds of cultural heritage. And women tend to value cultural heritage higher than men.

The age variable has a significant and positive influence on the valuation of tangible cultural heritage (such as architecture, monuments, and the urban landscape), and a negative influence on the intangible cultural heritage valuation of cultural events, traditions, customs and

knowledge. Education follows the same pattern: lower-educated tourists have a higher preference for intangible cultural heritage. In addition, the country of residence particularly affects the preference for intangible kinds of cultural heritage: almost all country (of residence) dummies are significant for the cultural events, traditions, customs and knowledge models. For the last three models, being a non-Dutch visitor increases the chance that one values these three cultural amenities more. Furthermore, Dutch tourists more often prefer cultural events.

As noted above, a factor analysis is carried out next as a second step performed in order to extract groups of tourists with more or less the same preferences. The factor analysis that deals with the preferences and plans of tourists visiting Amsterdam extracts 5 factors which explain 58 per cent of the variance (see Appendix 1 for the exact loadings):

1. *Intangible cultural heritage enthusiasts*: persons who like all kinds of cultural heritage, but in particular the intangible ones such as traditions, customs and knowledge. They also plan to visit one or more museums.
2. *Nightlife enjoyers*: tourists who are not interested in cultural heritage, especially not in architecture and museums and so on; instead they come to enjoy the city's nightlife and atmosphere.
3. *Tangible cultural heritage fans*: tourists who are not interested in intangible cultural heritage but who planned to visit architecture, museums and the urban landscape.
4. *Cultural events visitors*: tourists who are specifically interested in cultural events and who also planned to visit such an event.
5. *Shopping addicts*: tourists who come to shop in Amsterdam.

With the help of factor loadings[1] we can see which personal characteristics are related to these five groups of tourists. It appears that the cultural heritage enthusiast is often a younger female, visiting Amsterdam on a holiday trip and who is familiar with e-services. In addition, it is less likely that she is Dutch or from Germany, and more likely that she is from the UK, the rest of Europe or the rest of the world.

The nightlife enjoyers are generally young males, with a lower education and lower income. They are in Amsterdam for holiday reasons. Furthermore, they are generally not from the Netherlands, but from neighbouring countries or from the USA. The tourists who are particularly interested in tangible cultural heritage are often the older tourists, with a higher

[1] The factor loading is the Pearson correlation between a factor and a variable. Factor score coefficients can be calculated in several ways, the simplest way is the regression method. This means that the factor loadings are adjusted to take account of the initial correlations between variables.

education. They do not come for business reasons but for pleasure. They often come from Germany or from the rest of Europe.

The cultural events fans are often younger male tourists, who are not in Amsterdam for holiday reasons (but probably to visit friends), who do use e-services, and who generally come from the Netherlands. Finally, the shoppers: they can be typified as female tourists with a higher income, and and usually come from the UK.

6.3 Preferences for e-services

Not very surprisingly, it appears that tourists who already use e-services, in general have a higher appreciation for different types of e-services (see Table 2). Especially, the appreciation of an online booking service increases with the familiarity with e-services. Furthermore, we observe that education has a mixed effect. In general, when the coefficient of this variable is significant, education has a negative impact on the appreciation of different e-services. This variable is not significant for more or less 'traditional' e-services. E-forums, virtual tours, personalized information and interactive games are more 'modern' and 'trendy' forms of e-services and are more appreciated by less-educated tourists.

Gender only has a statistical impact on the appreciation of virtual tours and interactive games. It appears that men value these e-services more highly than women do. In addition, younger tourists also favour these kinds of e-services. More generally, younger people tend to find e-services more important than older people. Possibly, older tourists are less familiar with e-services such as e-forums and interactive games.

Concerning the country of residence it appears that tourists from the USA or Canada value some e-services (respectively, interactive maps, personalized information and booking services) more highly than tourists from the Netherlands. It is possible that these e-services are (already) more common in the United States or Canada.

The factor analysis dealing with the preferences of tourists in Amsterdam for different kinds of e-services results in two factors, which together explain 57 per cent of the variance (see Appendix 2 for the exact loadings):

1. *e-Services enthusiasts*: persons that appreciate e-services in general.
2. *Fans of interactive games*: tourists that prefer interactive games, but who have no preference for online booking.

The personal characteristics of the tourists who can be labelled as e-services enthusiasts are: younger tourists, males, and persons with a lower education. They use e-services and are also interested in many kinds of cultural heritage. There is a positive relation with tourists who visit Amsterdam for pleasure, from the UK or the rest of Europe

Table 2. Coefficients of the ordered logit models estimating the preferences of tourists in Amsterdam for different types of e-services

	Interactive map	Personalized information	Booking service	Journey planner	e-Forum	Virtual Tours	Interactive games
e-Service	0.497***	0.343**	1.156***	0.373**	0.362**	0.193	0.091
	(0.156)	(0.153)	(0.164)	(0.157)	(0.147)	(0.152)	(0.168)
Education	0.074	-0.205***	0.055	0.026	-0.210***	-0.124*	-0.339***
	(0.062)	(0.065)	(0.065)	(0.059)	(0.063)	(0.065)	(0.070)
Gender	0.082	-0.070	-0.065	0.158	-0.094	-0.294**	-0.423***
	(0.147)	(0.145)	(0.148)	(0.144)	(0.142)	(0.143)	(0.161)
Age	-0.189*	-0.182	-0.248**	-0.103	-0.470***	0.011	-0.434***
	(0.114)	(0.117)	(0.116)	(0.107)	(0.107)	(0.114)	(0.123)
Employed	0.317**	-0.026	0.098	0.167	0.177	0.186	-0.054
	(0.160)	(0.163)	(0.157)	(0.152)	(0.152)	(0.152)	(0.178)
USA	0.814***	0.706***	0.755***	-0.294	0.261	0.341	-0.171
	(0.217)	(0.235)	(0.241)	(0.214)	(0.215)	(0.228)	(0.252)
UK	0.594**	0.601**	0.680***	0.368	0.254	0.458*	0.675***
	(0.245)	(0.262)	(0.234)	(0.244)	(0.251)	(0.235)	(0.259)
Germany	0.328	0.247	-0.047	-0.808***	-0.070	0.052	0.131
	(0.233)	(0.234)	(0.243)	(0.232)	(0.232)	(0.231)	(0.273)
Rest of Europe	0.894***	0.792***	0.593***	-0.500**	0.460**	0.396*	0.286
	(0.217)	(0.225)	(0.221)	(0.219)	(0.230)	(0.214)	(0.248)
Rest of the world	0.823**	1.021***	1.315***	-0.471	0.735***	0.283	0.351
	(0.331)	(0.278)	(0.291)	(0.303)	(0.260)	(0.272)	(0.315)
Observations	650	651	651	651	651	651	650
McFadden pseudo-R^2	0.026	0.022	0.055	0.018	0.027	0.010	0.047

*Note: Significant at the *** 0.01, ** 0.05 and * 0.10 levels.*

The tourists who are interested in online games and not in an online booking system are also often younger tourists, male with a lower education and income. A strange result is that they do not use e-services when planning their leisure time. However, that would explain why they are not interested in an online-booking system, but more in online games. They are not so much interested in tangible cultural heritage, but more in cultural events. They often come from Germany.

7. Micro-simulation

7.1 Introduction

Micro-simulation (MSM) is a technique that aims to model the likely behaviour of individual persons, households, or individual firms, and combines *communicative* qualities

together with more *analytical* qualities. In simulation modelling, the analyst is interested in information relating to the joint distribution of attributes over a population (Clarke and Holm 1987). In these models, agents represent members of a population for the purpose of studying how individual (i.e. micro-) behaviour generates aggregate (i.e. macro-) regularities from a bottom-up approach (e.g. Epstein 1999). This results in a natural instrument to anticipate trends in the environment by means of monitoring and early warning, as well as to predict and value the short-term and long-term consequences of implementing certain policy measures (Saarloos 2006). The simulations can be helpful in showing (a bandwidth of) spatial dynamics, especially if linked to geographical information systems.

MSMs can be developed in different ways, the choice between these characteristics relates, on the one hand, to the problem or situation to be analysed, and, on the other hand, to data availability (see also Ballas et al. 2005). Three ways to classify MSMs are: static/dynamic; deterministic/probabilistic; and spatial/non-spatial.

First of all, models can simulate developments in the short run, without allowing the households to change (for instance, by getting older). This is called a 'static MSM'. The agents do not change, but, for example, their actual behaviour can change or the distribution of benefits over the agents may change. When a model takes into account longer-term developments with an explicit consideration of time, it is called a 'dynamic MSM'. In this case, the agents do change over the years; they get older, start relationships, or have children, etc. It is obvious that dynamic models are more complex, and, in general, need more data input.

The rules which determine the characteristics of the agents (in both static and dynamic models) can be deterministic or probabilistic. In a deterministic model, the relationships are fully determined by the parameters defined within the model; therefore, in a real deterministic model the patterns of outcomes will always be stable. Often, national data is reweighted to fit small area descriptions. Obviously, the total number of households, or the total number of families with children in a small area should be the same every time. A probabilistic (or stochastic) model incorporates random processes: for example, by using Monte Carlo simulations, either to reflect the random nature of underlying relationships or to account for random influences. Often, a combination of deterministic and probabilistic processes is used (Zaidi and Rake 2001).

A major advantage of MSM concerns the ability to address a series of important policy questions. Micro-simulation is particularly suitable for systems where the decisionmaking occurs at the individual unit level, and where the interactions within the system are complex. When the consequences are very different for different groups and thus difficult to predict, MSMs are well-suited to estimate and analyse the distributional impacts of policy changes, as they are concerned with the behaviour of micro-units (Mertz 1991).

7.2 Using a micro-simulation approach in simulating visitor flows

In the tourism literature, it is often mentioned that measuring demand is obstructed by the lack of suitable data, and that the number of studies aimed at modelling tourism behaviour is limited. One notable exception is the study of Lundgren (2004) in which information from the Swedish Tourism Database was integrated into the spatial MSM model SVERIGE by means of a separate module. This tourism module consists of socio-economic attributes which are also used in SVERIGE. Changes in population characteristics can in this manner be fed into the tourism module. The creation of this linkage enables the simulation of the effects of changes in the Swedish population on the size and direction of tourism flows. Furthermore, the adjusted SVERIGE MSM model allows for the analysis of possible adjustments in the direction of tourism flows by changes in the environment with respect to the location of tourism attractions.

Unfortunately, we do not have a dynamic MSM model at our disposal such as SVERIGE. Therefore, in order to simulate tourism in appropriate places, we will use a spatial deterministic MSM model, i.e. SIMtown (see van Leeuwen, 2008). This MSM model can be enhanced by including a behaviour module describing and predicting the choice of (individual) tourists for a tourist or cultural heritage attraction in the city concerned.

To construct the behaviour module, information about the total number of visitors in the cities, together with certain characteristics describing these visitors, is necessary. Another important input is the results produced by the choice experiment already conducted in the ISAAC-project Deliverable 1.4 (2007) and the results of the application of the Tourist Satisfaction System.

The tourists will be simulated at the municipality level. Therefore, we use 4 constraint variables (see next section). We only look at visitors who stay for at least one night, which results in a total tourist population of around 4.9 million tourists.

7.3 Constraint variables

Constraint variables are used to fit the micro-data to the real situation. They are (the most) important characteristics abstracted from the literature review and the behavioural models. Each of the constraints must be present in both the base survey (micro-data set) and in other databases, in this case, several sources from O+S Amsterdam (2008), ATCB (2008), and Statistics Netherlands (2007).

The choice of which variables to use is very important as it affects the outcomes. In some models, the order of constraints in the model, as well as the number of classes distinguished, also has an effect on the results. Unfortunately, there are only a few publications which deal with these issues (e.g. Smith et al., 2007). Furthermore, the best variables to use as a constraint are not always available. In our case, more detailed information about the characteristics of tourists in

Amsterdam is rather limited. However, by coupling different datasets we could derive information for four important variables, which are described below.

Goal

The first constraint variable is the goal of the visitor. The purpose of the trip can be either enjoying a holiday or doing business. Although the visiting goal does not affect the interest of a tourist in cultural heritage (therefore it is not included in the ordered logit models), it does affect the possibility that the person will actually visit cultural heritage in the city[2]. According to O+S Amsterdam (2008), the share of business visitors is 39 per cent. This is also the figure we use for the simulation.

Age

From the logit models, it appeared that age is an important variable for estimating a certain interest in cultural heritage. The ISAAC database uses five age-classes, but, because the last class (older than 74) includes only a few respondents, we merged it with the age group of 55-74 years. The ATCB research also shows the visitors per age category. Because the age-groups are slightly different, we had to recalculate the results from ATCB to fit the ISAAC age-groups. Therefore, we assumed that the number of tourists is equally distributed over the number of years in the class. For example, when the age class included 16-25 years, we assume that 10 per cent of the persons in this class has the age of 16.

Education

Finding reliable information about the employment situation or education level of tourists turned out to be very difficult. We focused on education because this variable is often mentioned as being important in the literature, and it is significant in the logit models. The NBTC, the Netherlands Board of Tourism and Conventions, in a report about foreign tourists in the Netherlands (2006), shows the average education level of tourists according to their country of residence. We assume that this distribution is similar for the city of Amsterdam. We distinguish between a primary, secondary and higher education level.

[2] Besides business and tourists purposes, the ISAAC database also distinguishes visiting family and friends. We assigned those persons to the tourists, as was also done in the ATCB 2008 report.

Country

The final constraint variable we use is the country of residence. We distinguish between the Netherlands, Germany, UK and Ireland, the rest of Europe, USA, Canada and Australia and the rest of the world. For the total number of tourists per country visiting Amsterdam, we used data from O+S Amsterdam (2008).

When we compare the sample with the actual situation (from external statistics) it appears that there are some discrepancies. In particular the share of business tourists is unrepresented in our sample, the share of younger tourists (18-34) is rather large and the share of lower educated tourists very modest. These inconsistencies will be eliminated in our micro-simulation. However, the share of higher-educated tourists, and the share of tourists according to their country of residence is very similar to the actual situation.

7.4 Sensitivity analysis tourists

A technical disadvantage of MSM is the difficulty of validating the outcomes, since it estimates distributions of variables which were previously unknown. One way of validating the results is to re-aggregate estimated data sets to the level at which observed data exist and compare the estimated to the observed distributions.

Another challenge in MSM is that, when simulating the effect of a certain event on the behaviour of households, usually a (behavioural) model is required. Different kinds of models are suitable, but, nevertheless, the results depend on these differences. It is important that the model is robust. However, when it is working, often a wide range of effects can be simulated.

Our MSM approach is necessarily affected by some statistical assumptions. Because of a lack of (clear) information about tourists, it is difficult to evaluate the results of the MSM. However, we will try to make an evaluation of the outcomes of the simulation model using the standardized absolute error measure (SAE) as described by Voas and Williamson (2001). The measure sums the discrepancies (TAE = total absolute error) divided by the number of expected tourists:

$$TAE = \sum_{k} \mid T_k - E_k \mid$$

$$SAE = TAE / N ,$$

in which T_k is the observed count of cell k (e.g. number of tourists from Germany), E_k the expected count for cell k, and N the total expected count for the whole table (total number of tourists in Amsterdam). Of course, it is also necessary to have an error-threshold. Clarke and Madden (2001) use an error threshold of at least 80 per cent of the areas with less than 20 per cent error (SAE<0.20). In a medical study, Smith et al. (2007) work with a model that simulates

persons with diabetes, which is a relatively rare disease, and therefore use an error threshold of less than 10 per cent error (SAE<0.10) in 90 per cent of the output areas.

The Amsterdam tourists are simulated at the municipality level (see Table 3). When looking at the SAE values, it appears that the simulation results are quite robust. In the total tourist population, we have a small underestimation of the number of business visitors. However, this is not a real problem because different sources gave different shares of business visitors. ATCB (2008) gives a share of 30 per cent of business visitors (instead of the 39 per cent we used from O+S Amsterdam (2008)).

The age groups appear to be very well simulated, and the education groups also seem quite robust. The only weaker part of the simulation is the overestimation of Dutch visitors by around 9 per cent. This is something we have to keep in mind, although, there is a recent tendency for the share of Dutch tourists to grow.

It is always relevant to compare the indirect results from the MSM with existing results; these are called the control variables. A first control variable could be the distribution of male and female tourists. No information can be found about the gender of national and international tourists in Amsterdam or the Netherlands. However, Statistics Netherlands (CBS) (2007) indicates that of all Dutch persons who go on holiday half are male and half female. Our simulated tourist population contains 51 per cent female tourists which is a very good result.

Table 3. Standardized Error Measure (SAE) for the 4 constraint variables simulating tourists in Amsterdam

Constraint	Class	SAE
Goal	Holiday	0.04
	Business	-0.04
Age	<18	0.00
	18-34	0.01
	35-54	0.01
	> 55	-0.02
Education	Primary	-0.04
	Secondary	0.06
	High	-0.02
Country	Netherlands	0.09
	Germany	-0.01
	UK	-0.01
	Rest EU	-0.05
	USA	-0.01
	Canada and Australia	-0.01
	Rest of the world	-0.03

Another control variable could be the number of nights of stay. From the micro-simulation we can derive the average number of nights that visitors from different countries stay in

Amsterdam. Because in the questionnaires the number of days that people intend to stay was asked, we first subtracted one day to get an estimation of the number of nights. That resulted in an average of 2.9 nights of stay for all tourists (see Table 4). Dutch tourists stay, on average, a little bit more than 1 night, tourists from the UK or Germany almost 3 days, and tourists from countries further away stay on average almost 4 days. When we compare this with results from O+S Amsterdam (estimated by dividing the number of nights spent by guests from a specific country over the number of guests from that same country[3]) or from the ATCB (from the visitors profile 2008), it appears that the simulation results fall in between the results of those two sources. Only the average stay of Dutch tourists is relatively low. This means that we could use these results, keeping in mind that the Dutch tourists probably stay longer.

Table 4. Average number of nights of stay from tourists of different countries according to our simulation, the Amsterdam City Department on research and statistics (O+S), and the Amsterdam Tourism & Convention Board (ATCB)

	Holland	USA	UK	Germany	Rest EU	Rest world	Total
Simulation	1 .3	2 .7	2 .8	3 .2	3 .7	4 .0	2 .9
O+S	1 .6	1 .8	1 .9	1 .8	1 .8	1 .9	1 .8
ATCB	2 .4	4 .6	3 .3	3 .7	4 .4*	-	4 .1

Note: *Average of France, Italy and Spain.

8. Target Group Tourists

The next research issue is whether different types of cultural heritage attract different tourist categories. In this section, insights from the behavioural models are linked to the simulated micro-population.

From the factor analysis applied to the data on the Amsterdam tourists, three groups of tourists can be distinguished: tangible cultural heritage fans, intangible cultural heritage fans; and tourists that particularly like cultural events. From the (simulated) micro-population of the Amsterdam tourists, we selected those persons who more than the average tourist favour one of those three groups of cultural heritage, and that do use e-services to plan their leisure time (Table 5). Those persons can be seen as the easiest ones to reach with a promotion tool, so we call them the target group.

[3] The results from O+S Amsterdam comprise all visitors, both business and leisure travellers. The ATCB and simulation figures only include tourists. However, according to the ATCB, business travellers even stay a little bit longer that leisure travelers do. This means that this cannot explain the difference in outcomes.

On average, on a scale of 1-5 the appreciation for tangible cultural heritage (architecture, monuments, museums, and urban landscape) is around 4, for intangible cultural heritage (traditions, customs and knowledge) around 3.5, and for cultural events around 3.5. Therefore, we selected those persons who do use e-services and who value tangible cultural heritage higher than 4.5, intangible cultural heritage higher than 4.5 and cultural events higher than 4.5.

Table 5. Amsterdam visitors (very) interested in three types of cultural heritage

Kind of CH		Number of tourists	Share of total tourists (%)
Tangible	No visit	355,333	7
	Visit	782,272	16
Intangible		619,823	13
Cultural Events	No visit	606,073	12
	Visit	365,221	7
Total		2,728,722	55

For the tourists we also made the distinction between persons who planned to visit any (tangible) cultural heritage site or cultural event and those who did not. For the persons who prefer intangible cultural heritage, it is not possible to distinguish between visitors and non-visitors.

In total, 55 per cent of the visitors of Amsterdam can be labelled as part of the target group. Interestingly, 7 per cent of the tourist population is (very) interested in tangible cultural heritage but has not planned to visit any point of interest. Those people also use the Internet to plan their trip. Another 12 per cent of the tourist population is very interested in cultural events, but has also not planned a visit. Although the reason for not having planned a visit could be quite different for those two groups (if one likes cultural events, the right kind of event must be available at the right time to be able to visit it, while tangible cultural heritage is usually available the whole year round), they clearly consist of potential visitors of cultural heritage.

When looking at the preferences of the five target groups for e-services, it is very interesting to see that the values of those persons who did plan a visit and those who did not plan a visit are very different (see Table 6). First of all, the tourists who visited either a cultural heritage site or a cultural event show higher preferences for an interactive map than the ones who did not visit anything; this also holds for personalized information and virtual tours. At the same time, the tourists who indicated they did not plan to visit anything perhaps could not find the services they required because they had higher preferences for using an online booking system and a journey planner.

Table 6. Preferences for e-Services of tourists (very) interested in cultural heritage

		Interactive map	Personal information	Online booking	Journey planner	E-forum	Virtual tours	Interactive games
Low value (1+2)								
Tangible	No visit	35	39	12	8	53	28	87
	Visit	13	16	20	30	50	21	77
Intangible		19	18	10	10	29	23	70
Cultural Events	No visit	37	36	12	13	53	32	82
	Visit	5	4	34	39	47	6	79
High value (4+5)								
Tangible	No visit	65	35	88	80	18	48	13
	Visit	81	60	68	48	24	60	12
Intangible		74	59	75	79	36	59	18
Cultural Events	No visit	53	35	67	68	18	50	10
	Visit	92	73	61	51	26	75	13

Just as we found for the residents, tourists who appreciate intangible cultural heritage, also attach more value to an e-forum and to interactive games.

From these results, it appears that the target groups of interested tourists in cultural heritage who do use e-services are relatively large. A useful distinction to make should be related not so much to the kind of cultural heritage they prefer, but much more to if they have already planned to visit anything. The preferences for different kinds of e-services appear to depend strongly on this background factor.

9. Conclusions

Modern tourism is increasingly becoming a high-tech sector, even in areas which are traditionally perceived as low-tech domains, such as cultural heritage. e-Services are becoming an important tool in a competitive global tourist system. This also calls for due insight into the motives and preferences of visitors.

When looking at the preferences of tourists through an ordered logit model, we find a clear difference between tangible cultural heritage attractions (such as museums and architecture) and intangible cultural heritage attractions (such as traditions and knowledge). Older persons often favour tangible cultural heritage, while younger persons appreciate intangible cultural heritage. Furthermore, younger persons have a stronger preference for e-services in general, and for interactive games in particular. Secondly, gender influences the preferences of both tourists and residents: in general, women have a stronger appreciation for cultural heritage. Other relevant

variables are education level, being employed or not, and level of income. Higher-educated persons appreciate interactive kinds of e-services (e.g. e-forum, interactive games) less than lower-educated people, while the traditional e-services are generally valued more highly by higher-educated people (e.g. interactive map, booking service). This information calls for fit-for-purpose tourism strategies from the side of the city of Amsterdam

The tourism strategy of Amsterdam aims to change the image of the city by attracting a different mix of visitors and to get them to broaden their horizons by visiting more sites of interest, moving outwards from the immediate city centre. Therefore, they want to promote new aspects of the city's cultural heritage such as Amsterdam as cultural city or city of events. In addition, smaller attractions should also be integrated into Amsterdam's positioning strategy through the use of themes such as 2008's Hidden Treasures[4].

From the factor analysis carried out on information regarding the Amsterdam tourists, three groups of tourists who are interested in cultural heritage could be distinguished: intangible cultural heritage enthusiasts, tangible cultural heritage fans, and tourists who particularly like cultural events. The intangible cultural heritage enthusiasts are generally younger persons, women, both of whom already use e-services to plan their trips. They are often international tourists. Tangible cultural heritage fans are often older international tourists, with a higher education. The cultural events fans are often younger persons, men, who do use e-services, and generally come from the Netherlands.

From the micro-population of the Amsterdam tourists, a simulated database with 4.9 million tourists, we selected those persons that in particular favour one of those three groups of cultural heritage, and who do use e-services to plan their leisure time. Those persons can be seen as the easiest ones to reach with the promotional tool. Therefore, we consider these persons as target groups. Furthermore, a distinction was also made between persons who planned to visit any (tangible) cultural heritage site or cultural event and those who did not.

It appears that 23 per cent of the tourist population is (very) interested in the tangible cultural heritage, of whom 7 per cent has not planned to visit any point of interest. Those people are familiar with using the Internet to plan their trip. Another 19 per cent of the tourist population is very interested in cultural events, of whom 12 per cent has not planned a visit either. Although the reason for not having planned a visit could be quite different for those two groups, they clearly consist of potential (additional) cultural heritage visitors. In addition, we found that the

[4] A wealth of culture was revealed in 2008 in the theme year 'Amsterdam Hidden Treasures'. It enabled visitors from the Netherlands and abroad to discover the lesser-known attractions of Amsterdam.

preferences of the persons who did plan a visit, and the ones who did not plan a trip are very different. First of all, the tourists who visited either a cultural heritage site or a cultural event show higher preferences for an interactive map than the ones who did not visit anything; this also holds for personalized information and virtual tours. At the same time, the tourists who did not plan to visit anything, perhaps could not find sufficient information, because those persons have higher preferences for using an online booking system and a journey planner. Tourists who appreciate intangible cultural heritage, attach a higher value to an e-forum and to interactive games. It is obvious that the above-mentioned information is of strategic importance for the development of a promotion tool: different e-services can attract different users depending on whether they have already decided to visit a cultural heritage site or not.

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Appendix 1. Factor analysis for tourists in Amsterdam with respect to cultural heritage

	Factors*				
	1	2	3	4	5
Variance explained	20%	13%	11%	8%	6%
Preference					
Architecture	**.478**	**-.547**	.334	-.015	.103
Monuments	**.459**	**-.520**	.202	.148	.194
Museums	**.390**	**-.462**	.292	.286	-.025
Urban Landscape	**.397**	**-.505**	.194	-.099	.031
Cultural Events	**.336**	-.248	**-.520**	**.503**	-.146
Traditions	**.708**	.118	**-.419**	-.230	-.005
Customs	**.730**	.058	**-.380**	-.294	-.015
Knowledge	**.687**	.015	**-.374**	-.289	.046
Planning to visit					
Architecture	**.453**	.297	**.434**	.050	-.206
Museums	.317	.300	**.518**	.014	.093
Urban landscape	.378	.265	**.452**	-.223	-.262
Cultural Events	.340	.293	-.123	**.684**	-.241
Shopping	.160	.337	.057	.177	**.799**
Nightlife	.306	**.474**	-.046	.167	.284
Atmosphere	.389	**.514**	.201	.048	-.204

Note: *See Section 6.2 for the names of Factors 1-5.

Appendix 2. Factor analysis of tourist preferences with respect to e-services

	Factors*	
	1	2
Variance explained	42 %	15 %
Preference		
Interactive map	**.633**	-.254
Personal information	**.633**	-.035
Online booking	**.693**	**-.524**
Journey planner	**.613**	-.316
E-forum	**.633**	.291
Virtual tours	**.713**	.207
Interactive games	**.723**	**.679**

Note: *See Section 6.3 for the names of Factors 1 and 2.